Asbestos Bodies in Human Lungs at Autopsy

Dzidra Cauna, MD, Robert S. Totten, MD, and Paul Gross, MD

The incidence of asbestos bodies in the lungs was investigated in 100 autopsies of adults. Lung smears were taken from the sectioned surfaces of the upper and lower lobes of both lungs. The slides were dried and mounted without staining, and approximately 400 low-power fields were examined in each slide. Routine histological sections of unexpanded lungs were also examined in all cases. Asbestos bodies were found in 41% of the subjects. They were not encountered in persons up to 24 years of age. Among males the incidence was 47%, and in females 34%. Although significant microscopic pulmonary fibrosis was encountered in two positive cases, no instance of classical asbestosis was found. Mesothelioma of the pleura was not encountered. Primary lung carcinoma occurred in one patient with asbestos bodies and in one without.

Wagner and associates[1] reported on the occurrence of diffuse pleural mesothelioma in persons from a large asbestos mining area in the northwest of Cape Province, South Africa. Since mesothelioma of the pleura was regarded as an uncommon tumor, and was rarely seen elsewhere in South Africa, they undertook an investigation of these cases. In ten cases, lung tissues were available for microscopic examination and asbestosis was found in eight.

Thomson[2] reported seven cases of mesothelioma, four in the pleura and three in the adjacent peritoneum, encountered over a period of three years in the autopsy service of one teaching hospital in Cape Town. In all seven cases the microscopic picture was that of pulmonary asbestosis, with abundant asbestos bodies and fibrosis in the basal portions of the lower lobes. Since only one of these seven patients had a history of occupational exposure to asbestos, Thomson and his associates[3] undertook an investigation on the frequency of asbestos bodies in the lungs in general population of Cape Town in routine autopsies. Of 500 cases examined, 132 were positive for asbestos bodies. These results suggested that asbestos was becoming a modern urban hazard. According to Thomson et al,[3] world consumption of this mineral had increased from 300,000 tons in 1934 to 2,400,000 tons in 1961. It is used in a wide variety of industrial products such as asbestos roofing, roof tiles, ceilings, floor tiles, pipe and electrical insulation, carbrake linings, cement, etc. Since asbestos is virtually indestructible they predicted that the amount of air-borne asbestos fibers in cities would increase in the future and become a contaminant of the air. They further suggested that the results of life-long inhalation of these fibers might lead to almost universal basal asbestosis in adults, and a frequency of mesothelioma of pleura or peritoneum higher than that of bronchial carcinoma today. Asbestos has also been implicated as a possible factor

See also page 419.

in the development of carcinoma of the lung.[4] According to Doll[5] the risk of developing a lung cancer is increased among asbestos workers, but this is denied by others.[6,7]

As the United States accounts for roughly over one third of the world's consumption of asbestos, Thomson[8] initiated an investigation of the frequency of asbestos bodies in lungs in Miami, Fla, where even higher positive figures were obtained than in Cape Town.

Pittsburgh and its environs are free of asbestos mines, but it is a large industrial center with an expanding modern building program. The purpose of this investigation was to obtain preliminary data on the incidence of asbestos bodies in the lungs of patients who died at Presbyterian-University Hospital.

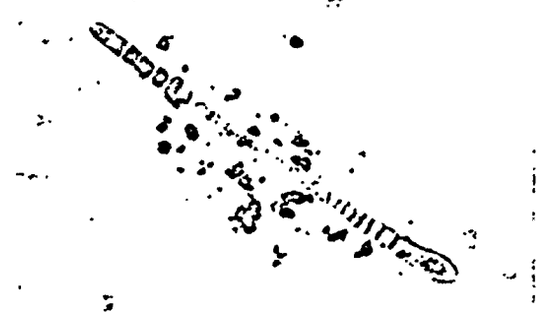
Material and Methods

The work was carried out in the Presbyterian-University Hospital, which receives patients mainly from the city of Pittsburgh and the surrounding area. The material consisted of 100 routine autopsy

1. Incidence of positive cases relative to age groups.

From the departments of pathology, Presbyterian-University Hospital and University of Pittsburgh School of Medicine (Drs. Cauna and Totten), and Industrial Hygiene Foundation, Inc., Mellon Institute (Dr. Gross), Pittsburgh.

Reprint requests to 230 Lothrop St, Pittsburgh 15213 (Dr. Cauna).



2. Asbestos body intimately related to a macrophage. Unstained lung smear of 65-year-old white scrap-iron dealer (×1,736).

3. Asbestos body intimately related to a macrophage inside an alveolus. Stained lung section of 57-year-old unemployed white male (×1,736).

contained coarse orange-brown granules, which also gave a positive iron reaction. Macrophages with these coarse iron-containing granules were also found in smears of six negative cases.

In histological sections of lung tissues asbestos bodies were found in only four positive cases, all among the higher counts. These bodies were situated within the lumina of alveoli and were usually partly enclosed by macrophages as in the smears (Fig 3). Interstitial fibrosis of some significance was observed in only three cases, two of them with asbestos bodies (three and four respectively) in the lung smears, and very few macrophages with coarse granules. In the third case with fibrosis, asbestos bodies were not found, but macrophages with coarse brown granules were seen in smears and histological sections. No case of classical asbestosis was found and mesothelioma of pleura was not encountered. Primary lung carcinoma occurred in one case with asbestos bodies and one without.

The fate of asbestos bodies in the lung is as yet not known. According to Knox and Beattie,[10] and Holt et al,[11] the bodies disintegrate after a period of time producing a large number of fragments which are collected in phagocytes. In our material, macrophages frequently contained coarse brown granules in asbestos positive and also in some negative cases. These granules gave a positive iron reaction, and judging by their size, they could constitute fragments of disintegrating asbestos bodies. However, since demonstration of iron in the coarse granules is not a positive identification of fragments of asbestos bodies, the question cannot be settled.

On the basis of their experiments with rats, Holt et al,[11] suggested that fibrosis of the human lung was not caused by asbestos bodies, but by small asbestos particles, derived from the break-down of these bodies. In our limited material no correlation between the presence of asbestos bodies or macrophages with coarse brown granules and pulmonary fibrosis was determined.

The overall incidence in this Pittsburgh series of 41% asbestos positive cases substantially exceeds that of Cape Town with 26.4%[3] and Miami[6] with 27.9%, the only two localities where this type of information is available for comparison so far. This may merely represent a difference in technique among the three groups or perhaps reflect a real difference in atmospheric pollution among the three cities. In any event the figures from these three widely separated urban communities indicate that asbestos bodies are commonly encountered in human lungs. It is suggested therefore that studies of this modern air contaminant should be extended.

This investigation was supported in part by Public Health Service grant HE-06675.

References

1. Wagner, J.C.; Sleggs, C.A.; and Marchand, P.: Diffuse Pleural Mesothelioma and Asbestos Exposure in the North West Cape Province, *Brit J Industr Med* 17:260-271 (Oct) 1960.

2. Thomson, J.G.: Mesothelioma of Pleura or Peritoneum and Limited Basal Asbestosis, *S Afr Med J* 36:759-760 (Sept) 1962.

3. Thomson, J.G.; Kaschula, R.O.C.; and MacDonald, R.R.: Asbestos as Modern Urban Hazard, *S Afr Med J* 37:77-81 (Jan) 1963.

4. Isselbacher, K. J.; Klaus, H.; and Hardy, H.L.: Asbestosis and Bronchogenic Carcinoma, *Amer J Med* 15:721-732 (Nov) 1953.

5. Doll, R.: Mortality From Lung Cancer in Asbestos Workers, *Brit J Industr Med* 12:81-86 (April) 1955.

6. Lanza, A.J.: *Pneumoconiosis*, New York: Grune & Stratton, Inc., 1963, p 24.

7. Braun, D.C., and Truan, T.D.: Epidemiological Study of Lung Cancer in Asbestos Miners, *Arch Indust Health* 17:634-653 (June) 1958.

8. Thomson, J.G.: Asbestos and Urban Dweller, read before the Conference on Biological Effects of Asbestos, New York, Oct 19, 1964.

9. Vasaamillet, L.F.: Personal communication to the authors, Jan 15, 1965.

10. Knox, J.F., and Beattie, J.: Distribution of Mineral Particles and Fibers in the Lung After Exposure to Asbestos Dust, *Arch Indust Hyg* 10:30-36 (July) 1954.

11. Holt, P.F.; Mills, J.; and Young, D.K.: Early Effects of Chrysotile Asbestos Dust on Rat Lung, *J Path Bact* 87:15-23 (Jan) 1964.